

$^{10}\text{B}(\text{He},\text{p}3\alpha),^{11}\text{B}(\text{He},\text{d}3\alpha)$  [2007Bo49](#),[2009Ki13](#),[2012Ai22](#)

Type	Author	History	Citation	Literature Cutoff Date
Full Evaluation	J. H. Kelley, J. E. Purcell and C. G. Sheu		NP A968, 71 (2017)	1-Jan-2017

[1968Kr02](#):  $^{10}\text{B}(\text{He},\text{p}\alpha)$  E=2.43 MeV, measured P- $\alpha$ -coin.

[1974Fo08](#):  $^{10}\text{B}(\text{He},\text{p}\alpha)$  E=1.8 MeV, measured  $\alpha$ -P-coin.

[2007Bo49](#):  $^{10}\text{B}(\text{He},\text{p})$  E=2.45 MeV, measured  $E_\alpha, I_\alpha$  from the triple  $\alpha$  breakup of  $^{12}\text{C}$  from ground state up to 18 MeV.

[2009Ki13](#): XUNDL dataset compiled by TUNL, 2009; updated, 2013.

$^{10}\text{B}(\text{He},\text{p})$  E=4.9 MeV and  $^{11}\text{B}(\text{He},\text{d}3\alpha)$  E=8.5 MeV, measured  $E_p, I_p, E_\alpha, I_\alpha$  in complete kinematics.  $^{12}\text{C}$  deduced  $\gamma$ -ray and  $\alpha$ -decay branching ratios from high energy levels, B(M1). The  $^{12}\text{C}$  excitation energies are deduced from the ejected proton or deuteron for the respective  $^{10}\text{B}$  or  $^{11}\text{B}$  target, while the final decaying  $^{12}\text{C}$  state is deduced from the relative  $3\alpha$  energy. Single step  $\gamma$ -ray transitions are assumed to account for the energy difference between the populated  $^{12}\text{C}$  state (deduced from p or d) and the  $3\alpha$  decay energy state. Authors deduced the overall decay branching ratios for  $^{12}\text{C}^*(12.71, 15.11 \text{ MeV})$ . The  $\gamma$ -ray transitions are deduced, not measured.

[2012Ai22](#): XUNDL dataset compiled by TUNL, 2013.

$^{10}\text{B}(\text{He},\text{p})$  E=4.9 MeV and  $^{11}\text{B}(\text{He},\text{d}3\alpha)$  E=8.5 MeV, measured  $E_p, I_p, E_\alpha, I_\alpha$  in complete kinematics at the Centro de Microanalisis de Materiales in Madrid. The projectiles were detected in an array of position sensitive  $\Delta E$ -E detectors that surrounded the target (38% of  $4\pi$ ). The  $^{12}\text{C}$  excitation energy is deduced from the proton or deuteron, for the respective  $^{10}\text{B}$  or  $^{11}\text{B}$  target, and in addition the relative  $3\alpha$  decay energy is used to exclude reaction channels such as  $^3\text{He}+^{10}\text{B} \rightarrow \alpha+^9\text{B}$  or  $^8\text{Be}+^5\text{Li}$  and  $^3\text{He}+^{11}\text{B} \rightarrow \alpha+^{10}\text{B}^*$  or  $^8\text{Be}+^6\text{Li}^*$  that may also populate the 4-body breakup channels. Further analysis also permitted separation of the  $^{12}\text{C}^*$   $\alpha_0$  and  $\alpha_1$  decay channels.

 $^{12}\text{C}$  Levels

E(level) <sup>†</sup>	$J^\pi$ <sup>†</sup>	$\Gamma$	Comments
0 $4.44 \times 10^3$	$0^+$		
7650 <sup>‡#@</sup>	$2^+$		
9641 <sup>‡#@</sup>	$0^+$		$\Gamma_{\alpha 0}/\Gamma = 100.00\%$ 1; $\Gamma_{\alpha 0}/\Gamma$ is corrected for the “ghost” threshold effect ( <a href="#">2012Ai22</a> ).
10.3 $\times 10^3$ <sup>#</sup>	$3^-$	43& keV 4	$\Gamma_{\alpha 0}/\Gamma = 100.0\%$ 4; $\Gamma_{\alpha 0}/\Gamma$ is corrected for the “ghost” threshold effect ( <a href="#">2012Ai22</a> ). $\Gamma_{\alpha 0}=43$ keV 4.
10847 <sup>‡#@&amp;</sup> 4	$(0^+)$		
12.4 $\times 10^3$ <sup>@</sup>	$1^-$	272& keV 5	$\Gamma_{\alpha 0}/\Gamma = 102.6\%$ 9; $\Gamma_{\alpha 0}/\Gamma$ is corrected for the “ghost” threshold effect ( <a href="#">2012Ai22</a> ). $\Gamma_{\alpha 0}=272$ keV 6.
11837 <sup>‡#@&amp;</sup> 4	$2^-$	229& keV 8	$\Gamma=\text{Broad}.$
12.710 <sup>‡#@</sup>	$4^-, 5^+, 6^-, 7^+$		$J^\pi$ : Unnatural-parity state with $J \geq 4$ ( <a href="#">2012Ai22</a> ). $\Gamma_{\alpha}/\Gamma=0.974$ 3, $\Gamma_{\gamma}/\Gamma=0.026$ 4. $\Gamma_{\alpha}/\Gamma$ : From ( <a href="#">2009Ki13</a> ).
13305 <sup>‡@&amp;</sup> 9	$4^-$	510& keV 40	$J^\pi$ : From ( <a href="#">2007Fr17, 2010Ki08</a> ), also see $J^\pi=(4^-)$ in ( <a href="#">2007Bo49</a> ).
14078 <sup>‡#@&amp;</sup> 5	$4^+$	273& keV 5	$\Gamma_{\alpha 0}/\Gamma=25\%$ 3; $\Gamma_{\alpha 0}/\Gamma$ is corrected for the “ghost” threshold effect ( <a href="#">2012Ai22</a> ). $\Gamma_{\alpha 0}=68$ keV 8.
15.11 $\times 10^3$ <sup>‡#</sup>	$1^+$		$\Gamma_{\alpha}/\Gamma=0.028$ 12 ( <a href="#">2009Ki13</a> ). $\Gamma_{\alpha}/\Gamma$ : Compare with ( <a href="#">1974Ba42</a> ) who give $\Gamma_{\alpha}/\Gamma$ , but who did not account for the 11.83 and 10.3 states. $\Gamma_{\alpha}/\Gamma$ : From ( <a href="#">2009Ki13</a> ).
16110 <sup>‡#@</sup>	$2^+$		$\Gamma_{\alpha 0}/\Gamma=7.2\%$ 9; $\Gamma_{\alpha 0}/\Gamma$ is corrected for the “ghost” threshold effect ( <a href="#">2012Ai22</a> ). $\Gamma_{\alpha 0}=0.38$ keV 5.

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 $^{10}\text{B}(\text{He},\text{p}3\alpha),^{11}\text{B}(\text{He},\text{d}3\alpha)$     **2007Bo49,2009Ki13,2012Al22 (continued)**


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 $^{12}\text{C}$  Levels (continued)


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E(level) <sup>†</sup>	J <sup>π</sup> <sup>†</sup>	Γ			Comments
$16.57 \times 10^3$ <sup>‡</sup> 20553 @& 5	2 <sup>-</sup> (3 <sup>+</sup> )	245 & keV 7	E(level): From (2007Bo49).		

<sup>†</sup> From Adopted Levels unless otherwise stated.

<sup>‡</sup> Reported in (2007Bo49).

# Reported in (2009Ki13).

@ Reported in (2012Al22).

& From (2012Al22).

 $\gamma(^{12}\text{C})$ 

E <sub>i</sub> (level)	J <sup>π</sup> <sub>i</sub>	E <sub>γ</sub> <sup>†</sup>	I <sub>γ</sub> <sup>‡</sup>	E <sub>f</sub>	J <sup>π</sup> <sub>f</sub>	Comments
12710	1 <sup>+</sup>	$2.41 \times 10^3$	0.9 6	$10.3 \times 10^3$	(0 <sup>+</sup> )	I <sub>γ</sub> : 0.9 +6–5.
		$5.06 \times 10^3$	2.6 16	7650	0 <sup>+</sup>	I <sub>γ</sub> : 2.6 +16–12.
		$8.27 \times 10^3$	12.7 24	$4.44 \times 10^3$	2 <sup>+</sup>	The authors give branching=96.6 +17–13 for decay to $^{12}\text{C}^*(0,4.4$ MeV). The evaluator has divided 96.6 into the $^{12}\text{C}_{\text{g.s.}}$ and $^{12}\text{C}^*(4.4$ MeV) branches using the branching ratios given in Adopted data set.
		$12.70 \times 10^3$	84 12	0	0 <sup>+</sup>	The authors give branching=96.6 +17–13 for decay to $^{12}\text{C}^*(0,4.4$ MeV). The evaluator has divided 96.6 into the $^{12}\text{C}_{\text{g.s.}}$ and $^{12}\text{C}^*(4.4$ MeV) branches using the branching ratios given in Adopted data set.
15.11×10 <sup>3</sup>	1 <sup>+</sup>	$2.40 \times 10^3$	1.2 2	12710	1 <sup>+</sup>	
		$3.28 \times 10^3$	0.32 12	11837	2 <sup>-</sup>	
		$4.27 \times 10^3$	<0.13	10847	1 <sup>-</sup>	
		$4.81 \times 10^3$	1.4 2	$10.3 \times 10^3$	(0 <sup>+</sup> )	
		$7.46 \times 10^3$	4.4 8	7650	0 <sup>+</sup>	
		$10.67 \times 10^3$	2.3 3	$4.44 \times 10^3$	2 <sup>+</sup>	The authors give branching=92.7 10 for decay to $^{12}\text{C}^*(0,4.4$ MeV). The evaluator has divided 92.7 into the $^{12}\text{C}_{\text{g.s.}}$ and $^{12}\text{C}^*(4.4$ MeV) branches using the branching ratios given in Adopted data set.
		$15.10 \times 10^3$	90.4 10	0	0 <sup>+</sup>	The authors give branching=92.7 10 for decay to $^{12}\text{C}^*(0,4.4$ MeV). The evaluator has divided 92.7 into the $^{12}\text{C}_{\text{g.s.}}$ and $^{12}\text{C}^*(4.4$ MeV) branches using the branching ratios given in Adopted data set.

<sup>†</sup> From energy level difference.

<sup>‡</sup> Deduced from indirect evidence observed in (2009Ki13).

$^{10}\text{B}(\text{He},\text{p}3\alpha), ^{11}\text{B}(\text{He},\text{d}3\alpha)$     2007Bo49,2009Ki13,2012Al22Level Scheme

Intensities: % photon branching from each level

